

OPTEC Laser – Dose Calibration

Here is described how to get the “Depth Vs Laser Dose” calibration curve for any given material.

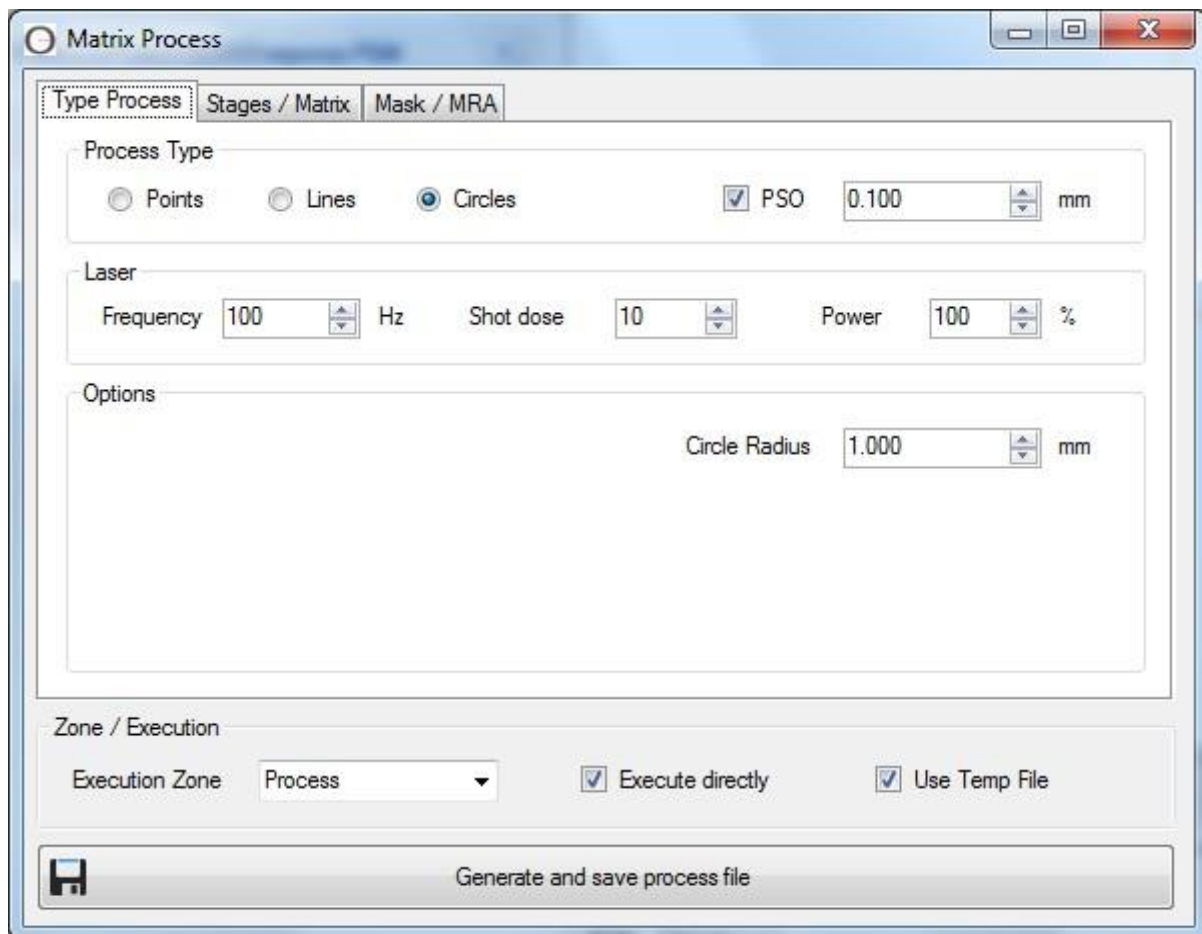
It is important to perform the calibration with a fixed couple of “demagnification + mask number”, corresponding to that of the final wanted machining size!

For the same output energy of the laser source, different couples of “demagnification + mask number” in the optical path can give equivalent final beam spot sizes, but different energy densities, hence different calibration curves!

For the same final spot size on the sample: higher demagnification => larger primary mask opening => larger amount of energy through! This is confirmed by measuring the energy delivered on the sample:

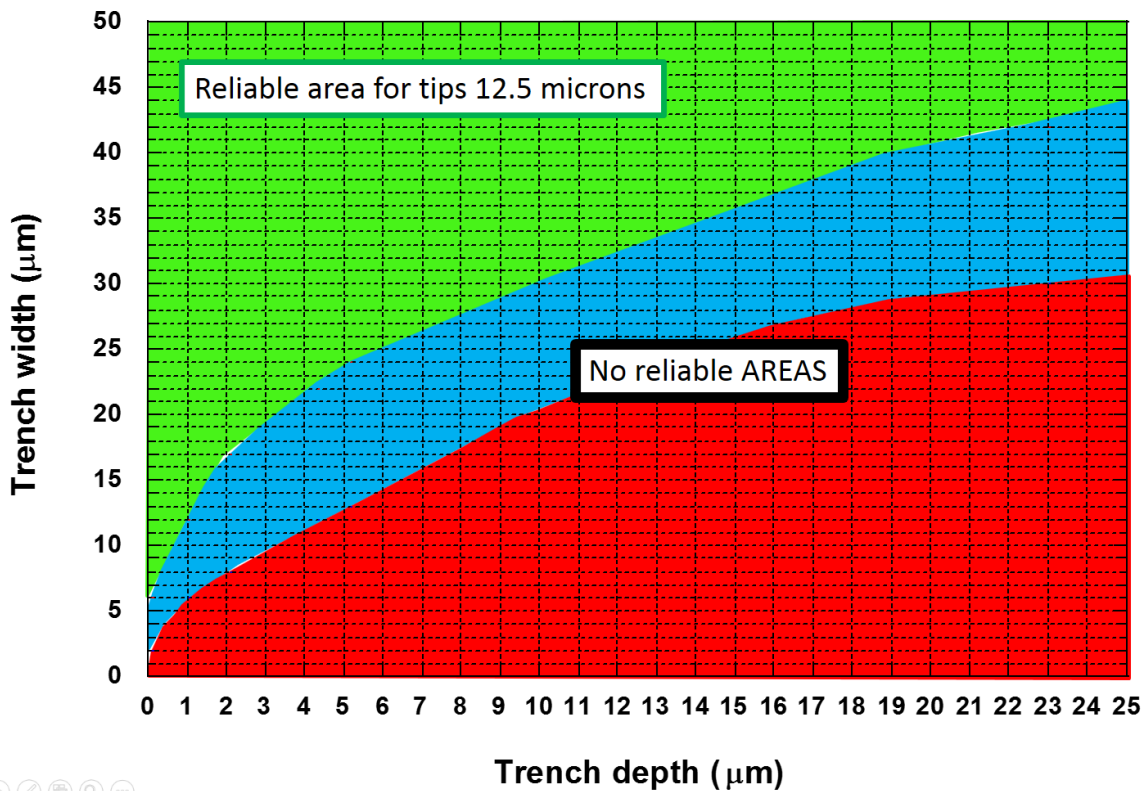
Laser setpoint	Demag	Primary mask opening	Final spot size on sample	Measured energy on sample	Energy density on sample
5mJ	10X	0.8mm	78µm	0.11mJ	2.2J/cm ²
5mJ	16X	1.25mm	77µm	0.22mJ	4.6J/cm ²

1. Start the “Matrix Process” from the *Tools* menu.
2. Into *Process Type*, select either “Points” (static calibration) or “Lines” (dynamic calibration).



If selecting “Points” for static calibration, make sure the machining holes are large enough so mechanical or optical measurements of the depth is possible! As a guideline, the mechanical profiler Dektak available at CMi is zone4 has a 12.5µm tip with following limits:

Measurement limits of Dektak profiler machine with a 12.5µm tip

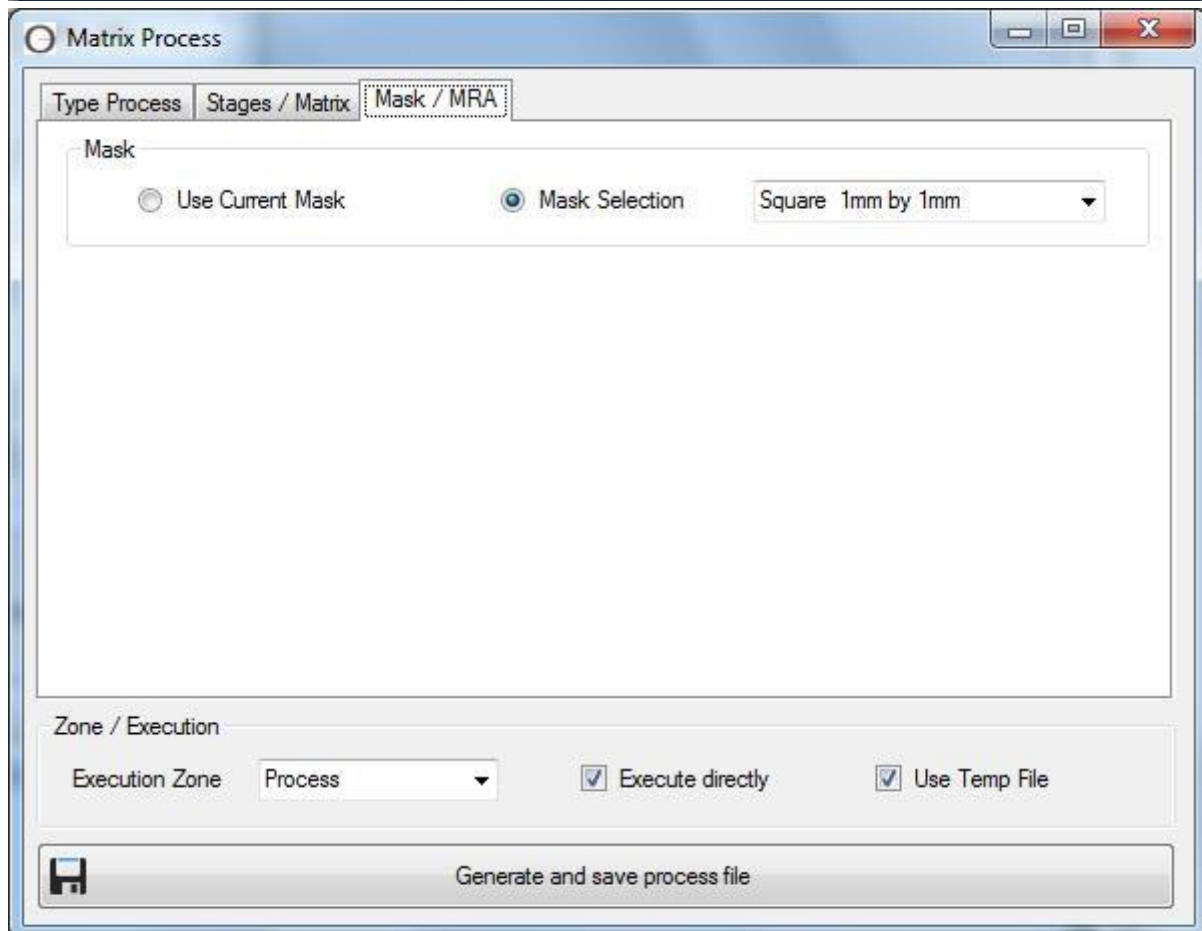
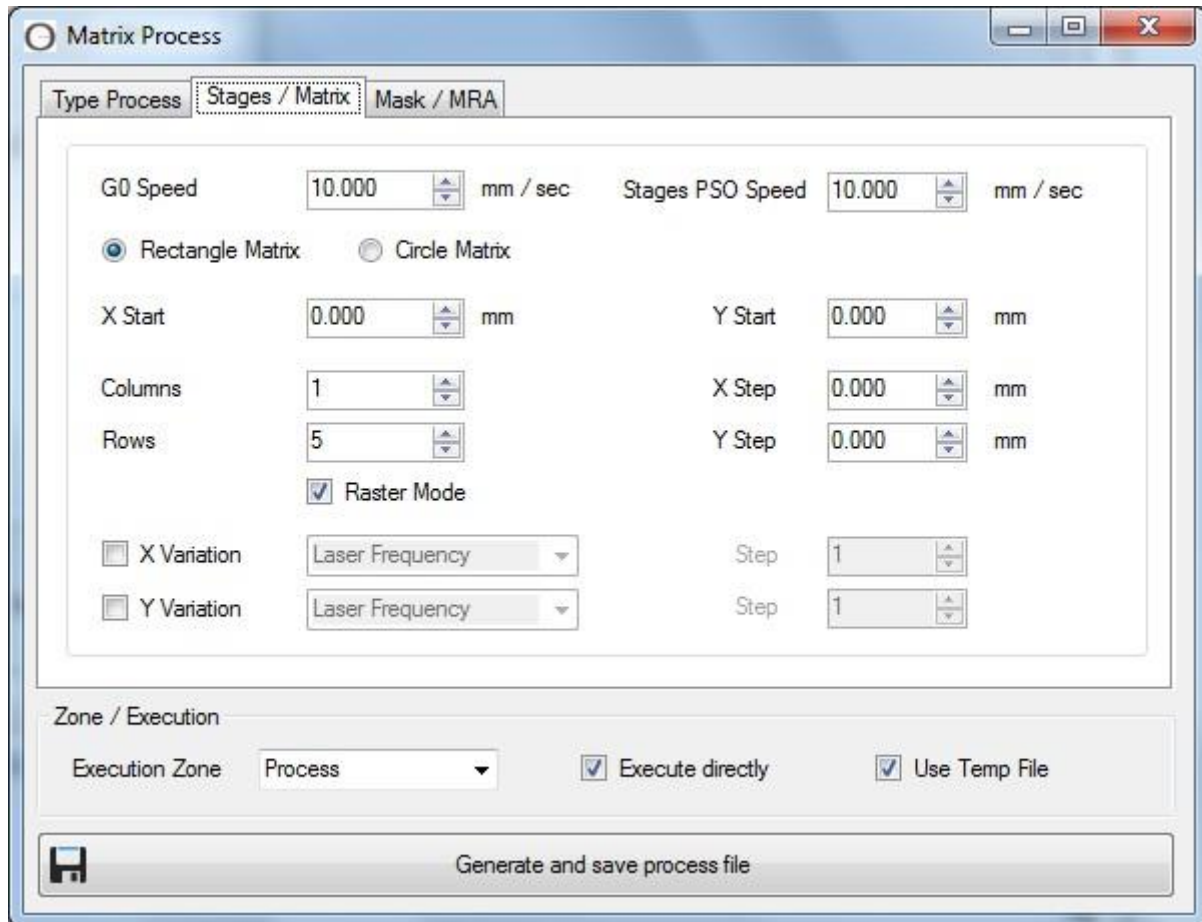


Also, when doing a static calibration with points, found values will still be valid for dynamic machining because the vector travelling speed of the stage will adapt itself to deliver a constant dose at each pixel of the design, i.e. at each “static” position. The vector travelling speed of the stage is calculated according the following formula:

$$\text{Speed} = \frac{\text{shot_frequency} * \text{spot_size}}{\text{shot_dose}}$$

If static calibration is not possible because the wanted machining width and depth do not allow for easy measurement, then the option “Lines” is needed to machine grooves. The sample will then have to be cut/cleaved through the grooves to allow for cross-section depth measurement (optical measurement).

3. Into *Laser*, define laser parameters for starting point of calibration.
4. Geometrical dimension of the matrix and laser parameters variation through the X and Y dimensions of the matrix is done in the “Stages/Matrix” tab.
5. The tab “Mask/MRA” allows selection of the primary mask opening.
6. The *Zone/Execution* gives options for executing the job directly or not, and/or to save the defined matrix or not.



Impact of demagnification setting on calibration curve
for a fixed spot size on sample

Kapton / 2.5mJ laser set point / no attenuation

